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By Staff, Division of Mining Research–Health and Safety

UNITED STATES DEPARTMENT OF THE INTERIOR
Cecil D. Andrus, Secretary

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MINE HEALTH AND SAFETY CONTRACT RESEARCH, DEVELOPMENT, AND DEMONSTRATION IN FISCAL YEAR 1979

by

Staff, Division of Mining Research–Health and Safety

ABSTRACT

This publication summarizes, for potential contractors and other interested parties, the research, development, and demonstration contract projects programed by the Bureau of Mines for fiscal year 1979 (October 1, 1978-September 30, 1979) under its Mine Health and Safety Research program. The objective of these projects is to provide an ordered and sequenced series of advances toward the Bureau's overall goal of providing the system technology required to create a healthier and safer working environment for the Nation's miners.

INTRODUCTION

It is the policy of the Bureau of Mines to utilize as fully as possible the capabilities of the private sector in mining research, and to that end this paper outlines the Bureau's present contract research needs to enable potential contractors to make decisions about participation in the program.

It is important to realize that since this is a summary document, the project descriptions related to a design, fabrication, and demonstration effort do not necessarily imply total package procurement. The projects presented here represent the plans conceived at the beginning of the fiscal year and are subject to change based on emerging priorities and the availability of funds. A companion publication, Information Circular 8798, lists in-house projects.

Contracting for the Mine Health and Safety Research program will be conducted in strict accordance with Federal Procurement Regulations. Availability of requests for proposals (RFP's) will be formally advertised in the Commerce Business Daily. No additional information will be supplied on these projects until after the RFP's are made available and then only in strict accordance with prescribed procedures. This document is not intended to solicit proposals from the contracting community. All unsolicited proposals (USP's) whose content reflects the objective(s) of proposed projects listed herein will be returned without formal review.

PROGRAM OUTLINE

The objective of the Mine Health and Safety Research program is to protect the health and safety of mine workers while insuring that newly developed mining technology incorporates health and safety criteria. In achieving this objective, four fundamental and complementary requirements must be considered by the research program, as follows:

1. Contributing to the viability of a basic industry.

2. Sustaining productivity.

3. Allowing for a return on capital investment.

4. Providing material and energy to the public.

Since mining involves a highly integrated and interrelated set of functions, the program has been divided into a set of interrelated subprograms, each with goals that will provide systems technology solutions to the problems within the framework of these fundamental requirements. The Mine Health and Safety Research program is divided into 12 subprogram areas as shown:

Health	Safety
Respirable dust	Fire and explosion prevention
Radiation hazards	Methane control
Noise control	Ground control
Industrial hygiene	Industrial-type hazards
Ventilation	Post-disaster
	Systems engineering
	Explosives

The objectives of these subprograms are described in the following pages, followed by the planned projects and their corresponding descriptions. It is not possible to give exact dollar estimates by subprogram area for competitive reasons, but the aggregate value of the anticipated contracts is approximately $37 million.

HEALTH

Respirable Dust

Program Objectives: To develop procedures for controlling the respirable mine dusts that still constitute the severest health problem facing the mining industries. To develop and/or improve techniques and equipment to prevent formation of hazardous dust concentrations, and to protect miners against dusty atmospheres.

Fundamental Studies

1. Mine Particulate Size Characterization

Objective: To evaluate and recommend techniques and equipment for determining inmine particle size distributions in noncoal mines. Equipment and procedures available for determining dust size in underground mines shall be surveyed, and equipment representative of accepted dust sizing methods shall be selected and obtained. Inmine experiments shall be conducted to determine the relative precision, accuracy, and limitations of each of the measurement techniques. Sufficient particulate size data shall be obtained to estimate variations in size distributions among different sources. This is a new RFP.

2. Study of Respirable Dust Research

Objective: To assess previous research in mine dust measurement and control by the Bureau of Mines and other organizations, review the current state of technology, and identify research needs. This study is being conducted by the National Academy of Sciences.

3. Survey of Dust Control Research by Industry

Objective: To conduct a survey of past and current research by the coal mining industry in order to determine the current methods being used by industry to control dust, the effectiveness of these methods, industry experience with the precision and reliability of dust measurements, and the effectiveness of Bureau technology transfer. This will be an update of a similar study done 6 years ago and will be a directed RFP.

Fragmentation Control

4. Improved Longwall Cutting

Objective: To combine the latest technology for the cutting of coal into one longwall shearer to demonstrate the reduction of respirable dust and specific energy while increasing production. The contractor shall perform underground cutting tests in a coal mine with both a standard and the new drum on a shearer. The tests should demonstrate that primary dust reduction is possible on a longwall shearer while maintaining or increasing production. This is a new RFP.

5. Evaluation of Novel Coal-Cutting Concepts for Reduced Dust Generation

Objective: To evaluate 10 novel coal-cutting concepts and determine their theoretical cost, production, dust generation, and maintenance problems or advantages. Some of the coal-cutting concepts include water-jet-augmented continuous miners, water jet miners, deep cutting, block mining, and self-advancing miners. The contractor shall rank all the concepts as to their dust production, machine cost, maintenance cost, coal production, and overall application and benefits in the coal mining industry. The contractor shall provide the Bureau of Mines with a sound, unbiased technical evaluation of

novel coal-cutting concepts so that the Bureau can choose the best one for development and demonstration. This is a new RFP.

Control of Generated Dust

6. Engineering Analysis of Alternatives To Reduce Miner Exposure to Respirable Dust

Objective: To investigate alternatives to methods currently being used to minimize respirable dust exposure and compare the technical risk, cost of implementation, and potential benefits with those of the currently used methods. For example, would an effective remote control system for a continuous miner be better, from a dust control viewpoint, than machine-mounted dust collectors? The project will provide a rationale, and set relative priorities, for development of alternative technologies to minimize miners' exposure to respirable dust. This is a new RFP.

7. Water Spray System Designs for Dust Control

Objective: To develop more effective use of water to control dust in underground mines. The contractor shall review and evaluate the state of the art and will recommend theoretical and/or empirical models for predicting dust control efficiencies. Specific application areas shall be selected, and prediction models shall be developed and verified through laboratory and inmine tests. Design and operation guidelines shall be developed. This is a new RFP.

8. Venturi Sprays for Dust Control on a Longwall Shearer

Objective: To demonstrate the effectiveness of venturi water sprays for dust control under U.S. longwall mining conditions. Work done on venturi sprays in Europe, particularly England, shall be used to build and install a venturi spray system on a U.S. longwall shearer. The design chosen shall be easily adapted to other shearers used in the United States. The contractor shall then conduct 30 total shifts of dust sampling with and without the venturi spray system to determine its effectiveness in reducing respirable dust levels. This is a new RFP.

9. Laboratory Testing of Airborne Dust Capture by Water Sprays

Objective: To determine the airborne dust capture efficiency of water sprays as a function of nozzle type, water pressure, and water flow rate. A laboratory facility shall be constructed for testing the dust capture efficiency of water sprays. Airborne dust capture efficiency shall be determined for various nozzle types, water pressures, and water flow rates. Patterns of air entrainment by the sprays shall also be determined. This is a new RFP.

10. Water Sprays To Improve Face Ventilation

Objective: To construct a full-scale, simulated drum-type continuous miner and mine entry and conduct tests to develop techniques for improving face ventilation effectiveness by using water sprays. The study shall

determine (1) how water sprays can be used to increase the dust cloud capture efficiency of machine-mounted ventilation and scrubber systems, (2) the effect of placing sprays adjacent to the machine operator to keep contaminated air at the face, and (3) the effect of the turbulence caused by sprays. This is a new RFP.

11. Water-Powered Scrubbers

Objective: To develop a 2,000-cfm dust collector (scrubber) that is powered by water only. This type of scrubber relies on the water to both move and scrub the air. The water-powered shrouded spray fan-scrubber shall consist of water spray nozzles, water droplet eliminator, and a commercial jet pump to loft the slurry water through a 10-foot static head. The system shall be designed for minimum size and cost. Contractor shall determine optimum nozzle location, nozzle type, and eliminator blade spacing, to achieve maximum air velocities. Water pressure at the nozzle shall be 100, 200, and 400 psig. This is a new RFP.

12. Surface Chemical Technology for Improved Wetting of Coal Dust

Objective: To develop specifications and requirements for surfactants that will wet coal. The contractor shall conduct laboratory measurements to characterize the surface properties of different coals. Surfactants shall also be ranked according to their physical and chemical properties, and a methodology shall be developed for matching coals with suitable surfactants. This is a new RFP.

13. Laboratory Testing of Flooded-Bed Scrubbers

Objective: To optimize the design of flooded-bed-type dust collectors as a result of laboratory testing. The effect of face velocity and bed thickness on dust collection efficiency and the most practical design based on dust collection efficiency, clogging (maintenance), cost, and use of water droplet eliminators shall be determined. This is a new RFP.

14. Inmine Tests for Wetting-Agent Effectiveness

Objective: To determine whether or not the use of wetting agents results in reduced airborne dust in coal mines. Verification shall be done through inmine tests using surfactants, which shall be selected on the basis of favorable results in laboratory tests. The inmine test data shall be evaluated and correlated with the laboratory data. This is a new RFP.

15. Evaluate Dust Sources and Control Techniques for Conventional Mining

Objective: To determine the magnitude of dust sources and the effectiveness of control techniques being used in conventional coal mining sections. Alternative techniques and hardware shall be studied to determine their applicability to conventional mining. Data shall be collected by inmine dust surveys. This is a new RFP.

16. Longwall Shearer-Mounted Dust Collector

Objective: To redesign a current model of a double-drum longwall shearer to incorporate a nominal 10,000-cfm scrubber system into the main body of the shearer or a 5,000-cfm scrubber system into each ranging arm. The system shall be designed to not degrade the productivity of the shearer. The dust collector is expected to be a flooded fibrous-bed type. This is a continuation of an ongoing effort.

17. Demonstration of a Dust Control System for Boom-Type Roadheaders

Objective: To eliminate the respirable dust problem on boom-type roadheading machines by installing either a wet-head or a dust collection ducting system on a roadheader. The contractor shall purchase either a wet-head system or a dust collector with ducting system for a roadheader. The contractor shall then install, optimize, and evaluate the chosen system for 20 shifts to determine its effectiveness and overall operation characteristics. This is a new RFP.

18. Survey on the Use of Dust Collectors

Objective: To determine experience over the past 10 years on the applications of dust collectors in the mining industry, document successful applications, and determine needs for further technical development. Dust collectors used in coal and noncoal mines and processing mills shall be included where the purpose of the collector is control of the occupational environment. Information sources shall include published technical literature and contacts with dust collector manufacturers, and with Mine Safety and Health Administration (MSHA), Bureau of Mines, and mining industry personnel. The final report shall contain all the survey results including the potential market for dust collectors in the mining industry, limitations on their use, and needs for further research and development. This is a new RFP.

19. Improved Dust Skirt for Blasthole Drills

Objective: To improve dust control of blasthole drills by developing a better dust skirt which confines the dust under all drilling conditions. The contractor shall survey and review existing dust skirts and then design, develop, fabricate, and test a simple rugged dust skirt or boot for blasthole drills. The basic design shall be easily retrofitted to both large and small blasthole drills. The skirt shall make a tight seal with irregular ground surfaces so that the sweep air draws all the dust into the dust control system. This is a new RFP.

Personal Protection

20. Feasibility of Using Cabs for Dust Control

Objective: To evaluate the feasibility of using cabs for dust control as well as noise control and operator safety on both surface and underground mining machines. The effectiveness of positive-pressure cabs where incoming

air is filtered through disposable cartridge filter units shall be determined. Human factors aspects of the use of cabs on mining machines shall be investigated, and limitations on the use of cabs on underground machines shall be determined. This is a new RFP.

Analytical Techniques and Equipment

21. Instruments and Techniques for Dynamic Particle Size Measurement of Coal Dust

Objective: To develop and evaluate instruments and techniques for measuring airborne respirable dust. To date the contractor has developed two dust-size-measuring systems and has completed a thorough evaluation for accuracy of two dust monitors--a beta absorption type, and a photometric type. The current objectives are to continue evaluations of commercial dust monitors; develop a compact, permissible dust-sizing instrument; develop a dust classifier; and build a submicrometer cascade impactor. This is a continuation of an ongoing effort.

22. Machine-Mounted Respirable Dust Monitor

Objective: To design and fabricate complete, machine-mounted dust monitors, install them onto selected mining machines, and intermittently repair them. The machine-mounted dust monitor is intended to replace most of the present program to enforce the 2.0-mg/m^3 standard for respirable dust in coal mines. The monitor shall automatically (1) measure average respirable dust concentration, (2) possibly turn the mining machine off for the rest of the shift if the shift average exceeds an input value, (3) signal when an excessive dust level occurs so that remedial measures can be taken, and (4) store the running shift averages for prior shifts for enforcement purposes. This is a new RFP.

23. Prototype Development of a Light-Scattering Machine-Mounted Dust Monitor

Objective: To design and fabricate four prototype machine-mounted dust monitors that utilize single-particle sensing techniques. The hardware shall be tested for electrical and mechanical reliability, permissibility, accuracy, and precision. The finished products shall be ready for underground tests and evaluation. This is a new RFP.

24. Rapid X-Ray Diffraction Device for Silica Analysis

Objective: To develop a new type of X-ray diffraction device specifically designed for rapid (less than 5 minutes), accurate analysis of respirable silica. Emphasis shall be placed on analyzing the dust on the field collection filter. A prototype device shall be assembled and tested with respirable dust samples containing silica. After a successful phase 1 demonstration, hardware shall be purchased and assembled for the new diffractometer during phase 2. Each phase shall cover 1 year for a proposed duration of 2 years. This is a continuation of an ongoing effort.

Radiation Hazards

Program Objective: To develop and provide new and improved measurement instrumentation and control technology for protection of miners from exposure to radon and radon daughters and other nuclear radiation hazards in uranium and other mines.

Control of Radon and Radon Daughters

1. Overpressurization Radon Control

Objective: To determine the effectiveness of positive pressure (2 to 5 inch, wg) in reducing the radon emanation in the ventilation of an isolated zone in a deep mine. The effect of the positive-pressure ventilation on a nearby mining area ventilated by negative pressure shall be evaluated. The effects of positive pressure on the migration of radon shall be determined. This is a new RFP.

2. Radiation Control of Uranium-Tailings-Backfilled Stopes

Objective: To evaluate the magnitude of the radon contamination problem from tailings-backfilled stopes, develop techniques for controlling the radiation from the backfilled stope if a radiation hazard exists, and test and evaluate the effectiveness of each control measure to develop proper design guidelines. This is a new RFP.

3. Design, Develop, Construct, and Field-Test Air-Cleaning Systems for Radon Daughter Control

Objective: To design, develop, construct and field-test air-cleaning systems for reducing radon daughter levels in working areas ventilated with auxiliary fans and remote from the main airways. In addition, performance and reliability characteristics shall be determined under active mine conditions, and the utility of the air-cleaning techniques shall be demonstrated to the industry. This is a new RFP.

Radiation Instrumentation and Measurement

4. Radiation Warning System for Uranium Mines

Objective: To develop and construct a radiation warning system using commercially available components where possible, and drawings and information supplied by the Bureau. The system shall be capable of informing surface mine personnel of hazardous airborne radiation conditions underground in uranium mines. The system's performance shall be evaluated and its reliability under active mine conditions shall be determined along with its advantages and disadvantages as a monitor of airborne radiation hazards. This is a new RFP.

Noise Control

Program Objectives: To identify noise sources in underground and surface mines and in related surface facilities, to abate these noise sources through both field retrofit and factory redesign approaches so that the mining operations and related activities meet the Federal noise exposure standards, to provide more accurate measurement and instrumentation of the noise environment, and to provide industry with the technical knowledge necessary to select, design, and implement noise control measures.

1. Development of Quiet Resilient Screens for Use in Coal Preparation

Objective: To develop quiet resilient decks for coal screening and to demonstrate their durability, maintenance considerations, acoustical effectiveness, and costs under long-term production conditions. Operational constraints to be investigated include wear and separation problems, blinding, material accumulation, and interference with production. This is a continuation of an ongoing effort.

2. Flammability Criteria for Acoustic Materials Used in Coal Mines

Objective: To assess the fire hazard of noise control materials and treatments that have potential for underground use. Materials to be considered include noise barriers, isolators, damping components, and noise absorbers. Selected materials will be tested according to standard tests of the American Society of Testing and Materials (ASTM) and evaluated in terms of MSHA's flammability requirements. This is a continuation of an ongoing effort.

3. Abatement of Noise of Continuous Miners

Objective: To develop and demonstrate both retrofit and design noise control measures on two continuous-mining machines. Participation of the contractor with equipment manufacturers and mine operators is necessary. Emphasis is to be placed on the test and demonstration of the noise control measures in the mining environment. This is a continuation of an ongoing effort.

4. Abatement of Airborne Noise Generated by Mechanical Coal-Cutting and Extraction Systems

Objective: To develop practical methods of abating the airborne noise generated by the cutting and extraction of coal by current and next-generation mining machines. Noise control modifications and redesigns for cutting and extraction devices shall be identified and evaluated. Hardware shall be developed to determine the effectiveness of the changes. This is a continuation of an ongoing effort.

5. Integration of Noise Abatement Technology Into New Person Trip Vehicles

Objective: To develop a low-noise person trip vehicle through redesign. that can be cost effectively manufactured and used in the mining environment.

Previous efforts in this area have involved retrofit noise abatement techniques. Participation of the contractor with equipment manufacturers and mine operators is necessary. This is a new RFP.

6. Preparation Plant Design for Quiet Operation

Objective: To demonstrate state-of-the-art noise control technology for preparation plants by redesign rather than retrofit techniques. This effort will be a cooperative agreement with a coal company, preparation plant designer and constructor, and the Bureau. Acoustical consultants will work with the builder during the design phase to specify and select equipment, processes, and techniques that will result in a facility that complies with the noise regulations. This is a new RFP.

7. Demonstration of Noise Control of Surface Mobile Equipment

Objective: To demonstrate that mine operators can successfully abate excessive noise from mobile surface equipment by utilization of available acoustic technology. This effort will be a cost-sharing agreement with a mining company. The mine operator shall serve as the prime contractor, providing mining machinery experience, and shall be complemented by an acoustical consultant. Equipment to be considered includes dozers, front-end loaders, trucks, and scrapers. This is a new RFP.

8. Investigation and Control of Acoustic Radiation From Auger Cutting Heads

Objective: To develop noise control techniques and hardware for control of acoustic radiation from auger cutting heads. A combined field and laboratory effort is required to measure the acoustic radiation, to determine the modes of vibration and radiation, and to devise control techniques. Hardware development will be accomplished with participation of the Wilcox Division of Fairchild Corp., the sole manufacturer of augers for underground use. This is a continuation of an ongoing effort.

9. Current Levels of Vibrations in Mines

Objective: To compile a current summary comparing the various physical parameters of vibrations to specific and/or suspected health effects, including physiological effects. This study is the initial step in the possible establishment of a program in this area. This is a new RFP.

10. Noise-Attenuating Properties of Earmuffs--Inmine Demonstration Phase

Objective: To evaluate the attenuation of A-weighted sound levels provided by earmuffs utilizing techniques of noise dosage monitoring. This is an inmine-testing phase of an ongoing effort.

11. Noise Study of Longwall Mining Systems

Objective: To develop quieter longwall mining equipment. The noise problems of longwall systems shall be indentified, and feasible engineering

controls that achieve quieter operation without affecting production shall be assessed and demonstrated. It is anticipated that this work will be a cooperative effort with a longwall equipment manufacturer. This is a new RFP.

12. Application of Quiet Stoper Drill Technology to the Redesign of Jumbo Drills

Objective: To develop a quiet jumbo-mounted drill through redesign techniques rather than through retrofit methods. The study shall involve noise control of both the drill body and the drill steel. Cooperation of a drill manufacturer is considered essential since manufacturing expertise is required, and the final prototype drill shall be field-tested to assess its long-term noise level, drilling efficiency, and other operational parameters. This is a continuation of an ongoing effort.

13. Development and Demonstration of Noise Control Techniques for the Crushing and Screening of Nonmetallic Minerals

Objective: To design, develop, and demonstrate the feasibility of noise-controlling equipment used in crushing and screening such nonmetallic minerals as sand and gravel, crushed stone, cement, lime, and lightweight aggregates. A number of different equipment types are to be selected including portable and stationary equipment. Noise control techniques shall be developed on equipment in production use, and abatement techniques used shall be evaluated in terms of durability, maintenance considerations, acoustical effectiveness, and cost. This is a new RFP.

14. Abatement of Taconite Plant Noise Sources

Objective: To develop and demonstrate practical engineering noise controls for equipment used in taconite plants. Prior work in this area determined the noise sources in taconite plants and concentrated on secondary crushers. This effort shall be aimed at quieting screens, rodmills, autogenous and semiautogenous mills, pneumatic rappers, and vacuum disk filters. Solutions developed shall be implemented in selected plants and evaluated to assess acoustic effectiveness, durability, and costs. This is a continuation of an ongoing effort.

15. Development of Retrofit Noise Control Kits for Load-Haul-Dump (LHD) Machines

Objective: To develop retrofit noise control technology for specific models of LHD machines. Noise control techniques shall be implemented and inmine-tested. Participation of the contractor with equipment manufacturers and mine operators is considered essential in conducting this contract. This contract is a continuation of ongoing efforts to quiet LHD's through retrofit means.

Industrial Hygiene

Program Objectives: To identify and control the health hazards created in underground mines by toxic gases and fumes, and by certain particulates produced by explosives and combustibles and by diesel engines. To develop new instrumentation for monitoring toxic components of the underground environment and evaluate commercially available instrumentation, to develop and/or refine analytical techniques for characterizing and measuring toxic components, and to investigate methods for controlling the formation and accumulation of toxic products.

Toxic Gases and Materials

1. Monitoring of Mine Air Pollutants

Objective: To perform the inmine measurements and the subsequent data analysis in order to identify and quantify the factors that influence workplace air quality in underground mines using diesel vehicles. The project will provide guidelines to MSHA on which measurements to take to assure good air quality with a diesel in use, and on how to take them. Inmine measurements of dust, CO, CO_2, NO, NO_2, diesel load cycle, and perhaps emissions, ventilation, and location shall be made with portable instruments, with a monitoring trailer, and with instruments located on vehicles and personnel. Laboratory analysis of H-C-N ratios on particulates shall be made, the field data shall be reduced, and air sampling statistics shall be worked out for several mines. This is a continuation of an ongoing effort.

2. Analysis of Toxic Fumes Generated During Shot Firing

Objective: To measure the toxic fumes developed by explosives at the working faces in mines. The contractor shall measure the toxic fumes developed by commercial explosives. Dynamite, water gel explosives, and ammonium nitrate-fuel oil shall be investigated in detail under various mining situations. The data shall be developed to supplement in-house data obtained in Bruceton, Pa., to help in the development of new Federal standards for toxic fumes from explosives. This is a new RFP.

3. Development of Handheld Indicating CO_2 Detector

Objective: To develop a lightweight, personal instrument for the accurate measurement of CO_2 in coal and other mine environments, in the range of 0 to 1 percent CO_2. Past data have shown the importance of ambient CO_2 measurements as an indicator of the effectiveness of ventilation at a work place using diesels, and other contracts have produced prototype CO_2 instruments based upon infrared and conductrimetric principles. The fiscal year 1979 effort will fund the final development of 20 prototype instruments of each technology for later field and trial demonstration. This is a continuation of an ongoing effort.

4. Development of Handheld Indicating SO_2 Meter

Objective: To develop and implement into the mining industry a small lightweight handheld direct-reading SO_2 gas detector. This instrument will enable the mine operator and MSHA to make more convenient, frequent, accurate, and less costly determinations of the SO_2 in the mine air. A type of sensor that has been successful as a CO_2 detector will probably be used to measure SO_2. Various electrode materials, chemical scrubbers, and the like shall be studied, and prototype cells shall be assembled for response, specificity, and life tests. This is a new RFP.

5. Electrochemical Sensors for Gases

Objective: To investigate a variety of electrochemical sensors for response to various gases. Such basic investigation is a part of the Bureau's effort to develop accurate, miniaturized, portable gas-measuring devices. This is a continuation of an ongoing effort.

6. Evaluation of Prototype Handheld Indicating Gas Detectors

Objective: To demonstrate and get field experience on the reliability of handheld gas detection instrumentation developed by Bureau contracts, to gain field failure data, and to promote implementing by the industry. A contractor will be given the responsibilities of disbursing the instruments into field operations, following and characterizing the instruments' use environment, repairing each instrument as needed, and documenting the repair record. Overall performance and acceptance of each instrument system by industry and other Government agencies such as MSHA, the National Institute of Occupational Safety and Health, and/or the Occupational Safety and Health Administration, shall be documented. This is a new RFP.

7. Development of Indicating CO Badges

Objective: To provide everyone in underground mines with a simple, inexpensive passive (or active) device that indicates to the wearer the approximate level of CO in the air. The form of the device would be a multi-element or sectional tag containing areas of color-indicating chemicals that are formulated to reversibly change color upon exposure to different CO levels. At least four formulations designed to have different color change points shall be made and when successful shall be fabricated into a badge device suitable for laboratory and field test. This is a continuation of an ongoing effort.

8. NO Dosimeter and NO_2 Alarm

Objective: To develop and test simple, passive personal devices to monitor personnel exposure to gases such as CO, NO, NO_2, and SO_2 in the range near or below the threshold limit value ceiling limit. The approach uses sampling techniques based on the molecular diffusion of the contaminant gas through an orifice to a trapping medium which is analyzed after exposure. Sample readout instrumentation of the device is also required after exposure. This is a continuation of an ongoing effort.

9. Hydrogen Cyanide Monitor Alarm

Objective: To develop a hydrogen cyanide monitor for mineral-processing plants that use hydrogen cyanide in the recovery process. Such a monitor shall be stationary and designed to continually monitor the general work area that could be subjected to possible high concentrations of hydrogen cyanide. The monitor shall signal an alarm in case of high concentrations. This is a new RFP.

10. Passive Samplers for CO and SO_2

Objective: To provide the mining industry and NIOSH with an acceptable device for cheaply and simply obtaining personnel exposure data to CO and SO_2 as a matter of routine. This year's work will involve field and laboratory trials of the samplers. Descriptive literature, reports, and publications shall be produced that fully describe the use of the samplers, so that firms specializing in industrial hygiene can adopt them as marketable devices. The data obtained in this study would be a good source of information for epidemiological studies; also, with these data, potential problems of exposure resulting from changing working conditions can be spotted and corrective action taken. This is a continuation of an ongoing effort.

11. Kit Development for Onsite Analysis of Potable Water

Objective: To provide a complete, portable field kit for the MSHA inspectorate. The kit must be able to measure chemical constituents that find their way into water sources, streams, etc. The kit must be designed to satisfy MSHA requirements of onsite analysis of elements specific to MSHA concerns. This is a new RFP.

Diesels

12. Reduction of Pollutants From Engines Operated Underground

Objective: To devise control measures for reducing emission levels of diesel engines approved for mine use. Levels of particulates, oxygenates, and other contaminants in diesel exhaust shall be measured before and after application of control systems such as scrubbers, filters, and catalytic converters. Combined use of such controls shall be studied to achieve pollutant levels below MSHA standards. This is a continuation of an ongoing effort.

13. Control of Diesel Exhaust Particulates in Coal Mines

Objective: To design a control device or devices for removal of at least 90 percent of particulates from coal mine diesel engine exhaust. The system(s) shall be tested in tandem with control units for removal of other pollutants. The system(s) shall be coupled with scrubbers and other control devices, and efficiency of pollutant removal shall be measured. The unit(s) should lower contaminant levels below MSHA standards. This is a continuation of an ongoing effort.

14. Development of Sampling and Analytical Methods for Toxicants in Diesel Exhaust Streams

Objective: To devise new and updated analytical methods for toxicants covered in fiscal year 1978 research. Laboratory and onsite tests of field-collected samples shall be conducted, using the best of the state-of-the-art procedures. Improvements made in methodology will help to improve credibility for test results obtained under adverse conditions onsite. This is a new RFP.

15. Alternative Fuels and Fuel Additives for Diesel Engines Operated Underground

Objective: To determine viable alternative fuels and fuel additives for reduced emissions in diesel engines operated underground. The contractor shall review all past and present research and recommend viable alternatives. Some of the fuels of interest shall be water-fuel emulsions and hydrogen-enriched fule oils; fuel additives shall include smoke suppressors and cetane improvers. In addition, areas such as fuel storage and handling, fuel metering and injection, and costs and availability shall be researched. This is a new RFP.

16. Feasibility of Particulate Removal in Turbocharged Diesel Engines

Objective: (1) To quantify particulate emission characteristics of large turbocharged aftercooled engines with concurrent measurements of gaseous emissions and particulates, and (2) to determine the feasibility of injecting water into the exhaust of a turbocharged diesel engine to remove particulates. In testing the effectiveness of water scrubbers in eliminating diesel exhaust particulates in connection with method 1, a dilution tunnel shall dilute the exhaust to 15:1. Samples of the scrubber water shall be taken at seven load-speed test points and analyzed for carbon content. Mass rates and concentrations of particulates, NO, CO, CO_2, and total hydrocarbons shall be calculated, and the efficiency of each scrubber in retaining these pollutants shall be determined. In method 2, various ways to condense water droplets nucleated on particulate matter must be investigated. Then, reduction in particulate concentrations shall be measured and compared with baseline engine data. If water injection is deemed feasible, methods of recycling and filtering injection water will be investigated. This is a new RFP.

17. Development and Utilization of the Stirling Engine for Powering Underground Mining Equipment

Objective: To demonstrate that a Stirling engine can be used to power underground mining machinery within acceptable emission levels, thereby removing the ever-hazardous trailing cable. The contractor shall assess the design changes needed to use the Stirling engine as an underground power source. This task area shall include projected ventilation requirements. The contractor shall make emission level measurements using an engine dynamometer and a simulated power duty cycle; these measurements shall be made on an existing engine so that design changes can be made directly to the engine. Full-mine-section air-quality monitoring shall be performed during vehicle

operation in the mine to quantify the mine air pollutant content if measurable. This is a new RFP.

Ventilation

Program Objectives: To apply ventilation technology previously developed for underground coal mines in metal and nonmetal mines; to expand and/or adapt such technology to meet special requirements of noncoal mines.

1. Assessment of Using Ventilation Airstream To Disperse Tracer Gas for Detection of Mine Fires

Objective: To assess the applicability of tracer gas techniques for detection of mine fires. A feasibility study will test the concept of using canisters that contain a mixture of gases that could be detected in dilute concentrations both by smell and by instruments and that are plugged with a low-melting alloy. If the concept is found to be workable, a mine demonstration will be conducted. This is a new RFP.

2. Assessment of Effectiveness of Janelid Ventilation System with SF_6 Tracer Gas

Objective: To use the sulfur hexafluoride technique to assess the method of mounting an induction fan on the rear of a diesel-powered loader to ventilate dead headings. The effectiveness of this system shall be compared with ventialtion achieved using an induction fan at the crosscut. This is a new RFP.

3. Development of Analog Device for Simulating Hardrock Mine Ventilation

Objective: To build an analog device to simulate mine ventialtion networks. The device shall be simple enough that personnel using it need have no training or experience with computers. The device shall be tested at a hardrock mine. This is a new RFP.

4. Determining Mine Fan Characteristic Curves Under Unique Operating Conditions

Objective: To develop a method for estimating the characteristic performance curves of main mine ventilation fans when operating in reverse, and also when operating under conditions different from those under which the fan characteristic curve was determined. A relationship shall be established for the reverse flow characteristics of each type of commonly used main mine ventilation fan. In addition, performance curves shall be determined for five ventialtion fans when operated under conditions different from those under which the accepted characteristic curves were obtained but commonly encountered in mine ventilation. This is a new RFP.

5. Assessment of Urea-Formaldehyde Foam in Sealing Mine Stoppings

Objective: To develop methods of building stoppings and techniques for repairing old stoppings with urea-formaldehyde foam. The practicability and effectiveness of these methods and techniques shall be tested in underground mines. The applied foam shall be evaluated for leakage, adhesiveness, and strength. This is a new RFP.

SAFETY

Fire and Explosion Prevention

Program Objectives: To develop procedures to (1) eliminate ignition sources, such as frictional and electrical sparks, (2) prevent the formation of flammable atmospheres in underground mines, (3) detect fires and explosions at the earliest possible stage, and (4) provide effective physical and/or chemical means of arresting and quenching fires and explosions when their occurrence cannot be otherwise prevented.

Ignition Research

1. Develop an Ignition-Quenching Device

Objective: To develop a methane-ignition-quenching device to effectively sense the ignition and to deliver a flame-suppressing agent. The system shall incorporate a sensory element compatible with the mine environment to minimize false firing, shall utilize an environmentally compatible quenching agent and delivery system, and shall not present a hazard to miners. Reassessment of past efforts shall be made to explore possible new approaches. This is a new RFP.

2. Study of Frictional Ignition

Objective: To reduce the incidence of frictional ignition in coal mines. Efforts shall be made to (1) minimize the development of sparks by varying bit speed, bit type, bit shape, lubricants, etc., (2) quench ignition with water, foam, inert gas, or steam, and (3) develop a monitor capable of being mounted at the bits or at least on the cutting head. This is a new RFP.

3. Explosion Hazard of Air Compressors

Objective: To permit development of standards for underground and surface air compressors in order to minimize air compression explosions. This work will probably consist of collecting and analyzing currently available domestic and foreign information specifying types of oils, temperatures, and other factors affecting compressor explosions. Laboratory work is not envisioned. This is a new RFP.

Flame Propagation

4. Study of Mine Fires and Mine Ventilation

Objective: To prepare a report on the precalculation of the effect of fires on ventilation systems in mines. The report shall contain practical applications of the previously developed computer program to account for the influence of mine fires on ventilation networks. Approximately six coal and metal and nonmetal mines shall be considered; at least one realistic fire scenario shall be considered for each mine. This is a continuation of an ongoing effort.

Fire Detection and Alarms

5. Analysis of Fire Safety Tests and Standards

Objective: To provide an analysis of fire safety tests and provide appropriate information for an MSHA standards-promulgation effort. This project is in support of a parallel effort being conducted by the National Bureau of Standards for MSHA. This is a continuation of an ongoing effort.

Suppression and Extinguishment

6. Development of Criteria and Methods for Determination of Compliance With Respect to Rock Dust in Coal Mines

Objective: To evaluate issues involved in the determination of compliance with respect to rock dust; evaluate guidelines for the development of decision models; and propose, develop, and evaluate statistical decision models, as well as indices of risk. Definitive tests shall be proposed to adequately evaluate the models and indices and assess adequacy of current regulations for rock dusting in coal mines. The contract shall continue to seek a basis for simplifying and expediting procedures for MSHA inspectors with respect to inert dust compliance in the presence of methane. Gaps in vital information shall be identified. This is a continuation of an ongoing effort.

7. Applicability of Mine Shaft Fire and Smoke Protection Systems in Coal Mines

Objective: To apply the technology developed an inmine-tested as a result of the metal and nonmetal safety contract "Mine Shaft Fire and Smoke Protection Systems" to the problem of fire protection in coal mine shafts. Prototype hardware shall be designed, built, and inmine-tested on a cost-sharing basis in at least two mines. The work shall be expanded to include fire protection while shaft sinking. This is a new RFP.

8. Develop Improved Fire Detection System for Deep Shafts and Beltway Haulageway Systems

Objective: To demonstrate the feasibility of multipoint tube-bundle sampling using a prototype sensor for underground fire protection. A multipoint tube-bundle network using a prototype sensor shall be installed in a metal and nonmetal mine and a coal mine belt haulageway. This is a new RFP.

9. Develop Thixogel Fire-Extinguishing Agents

Objective: To determine the feasibility and advantages of a thixogel fire-extinguishing system consisting of a gelled propulsion agent such as Halon 1301 and a powered extinguishant such as potassium bromate. It has been postulated that a gelled hybrid extinguishant should have certain advantages (for instance, freedom from agglomeration or compaction of the solid particles). The contractor shall prepare thixotropic systems and attempt to demonstrate the advantages with representative fires and possible explosions. This is a new RFP.

10. Gallery Testing Related to Mine Timber Fires

Objective: To operate a large-scale fire gallery for evaluating the relative effectiveness of fire safety measures proposed for use in metal and nonmetal mines and recommend improvements in mine safety based on results of fire trials. Fiscal year 1978 fire trials defined criteria for flame spread or nonspread in timbered entries in terms of ignition source strength, ventilation velocity, and fuel loading density. In fiscal year 1979, ignition source studies will continue, and evaluations of fire- and rot-retardant treatments and fire stops will be initiated. This is a continuation of an ongoing effort.

11. Improved Fire Protection Systems for Underground Fueling Areas

Objective: To evaluate the reliability and cost effectiveness of designs of improved hardware for underground fueling areas in mines. Three system design alternatives shall be evaluated: (1) Portable refueling stations, (2) fuel, and (3) permanent fuel transfer points. Prototype underground fueling area fire protection hardware shall be inmine-tested for at least a year in three underground mines. This is a continuation of an ongoing effort.

12. Combined Fire- and Rot-Retardant Treatment for Mine Timber

Objective: To develop a combined fire- and rot-retardant treatment for new and already installed mine timber to reduce fire and decay hazards. The work shall be continued with the following efforts: (1) Heavier treatments for particular danger points in mines, (2) additional fire- and rot-retardant systems including coatings with a time-release system and chemically treated precharred wood and new treatments, and (3) development of an inspection kit for on-the-spot guarantee of chemical treatment of timber and decay condition of timber. This is a continuation of an ongoing effort.

13. Fire and Explosion Hazards of Oil Shale Mining and Processing

Objective: To evaluate and demonstrate the fire and explosion hazards of oil shale mining and processing, both underground and on the surface. Previously, time and funds were sufficient only for laboratory-scale testing of combustion properties such as the limit of explosibility of oil shale dust (both by itself and with added methane), and for the ignition and burning of bulk material. Extension to large-scale fire and explosion tests is proposed. This is a new RFP.

14. Monitoring of Hydrocarbons in Oil Shale Mines and Mines Used for Oil Storage

Objective: To determine (1) the extent of underground atmospheric hydrocarbon monitoring needed, (2) the most effective and economical methods for monitoring active salt mines that have portions used for the storage of crude oil, and (3) the most effective and economical methods for monitoring oil shale mining. Mining situations shall be examined, and the necessity of monitoring schemes and monitoring systems shall be determined. The oil being stored shall be examined for its volatility, the chemical nature of gases released, and possible health, fire, and explosion hazards. This is a new RFP.

Gas Detection Instrumentation

15. Infrared Methane Monitor

Objective: To carry on the prior years' development of an infrared methane monitor into the industry, through industry use and cooperation. Through a cost-sharing arrangement, a quantity of methane monitors shall be fabricated and placed underground for field evaluation and demonstrations. Reliability and accuracy data shall be gathered. Thus, the mining industry will be able to obtain a more reliable methane monitor comparable in price to the catalytic monitors available today. This is a continuation of an ongoing effort.

Methane Control

Program Objectives: To prevent the formation of flammable methane-air mixtures in underground workings through improved ventilation and to develop procedures for degasifying the coalbed in advance of and during mining. To establish correlations between the geology of the coalbed and its gas content and use these to predict methane emission hazards.

Control During Mining

1. Develop New Method of Measuring Face Ventilation Effectiveness

Objective: To develop a better method of measuring the effectiveness of face ventilation in coal mines. A method involving simple instrumentation shall be developed to replace the current method of measuring the methane concentration at the head of the machine and in the immediate return. The

method shall be evaluated in laboratory and underground trials. This is a new RFP.

2. Assessment of Effectiveness of Vent Holes Drilled Into Sealed Gobs

Objective: To determine through an engineering feasibility study whether vent holes are a practical and effective way of controlling methane from a gob area that has been sealed. Many mines have gob seals adjacent to intake airways. When the barometer falls, these airways become contaminated with methane which leaks out of the gob as the gas mixture in the gob area expands. If the feasibility study indicates that vent holes are practical, a vent hole shall be drilled into a sealed gob. Effectiveness of the hole shall be assessed by monitoring seal pressures and concentration of methane in the gob. This is a new RFP.

3. Testing "Sideboard-Spray" Extensible Line Curtain System

Objective: To develop and test a design for a machine-mounted sideboard-spray ventilation system for continuous-mining machines. This system would permit the machine to make 20-foot cuts, thereby increasing productivity, while keeping the curtain within 10 feet of the face. This is a new RFP.

4. Evaluation of Effectiveness of "Operator-Adjacent" Water Sprays

Objective: To determine in underground mine tests the quantity of contaminated air reaching the operator from the face where coal is being cut by a continuous-mining machine both with and without water sprays installed immediately ahead of the operator. The location, direction, and water delivery of the operator-adjacent sprays shall be optimized to reduce the contaminated face air reaching the operator position. This is a new RFP.

5. Squeeze Block Evaluation and Improvement

Objective: To determine the best material for squeeze blocks used by some mines to prevent block stoppings from cracking and buckling because of convergence of roof and floor. The first part of the project shall be measurement of leakage through stoppings with and without squeeze blocks in mines that use squeeze blocks. In the second part, suitable new materials for squeeze blocks shall be obtained and evaluated. This is a new RFP.

6. Gob Purge Chamber To Reduce Oxygen Intake

Objective: To test the concept of separating the gob area and the seal with a purge chamber to decrease the quantity of oxygen leaking into the gob area. If the purge chamber is effective in reducing the oxygen concentration in the gob, the chances of spontaneous combustion in the gob are reduced. This is a new RFP.

7. Evaluation of Effectiveness of Stopping Coatings

Objective: To evaluate different types of proprietary stopping coatings in the laboratory and underground to determine what characteristics an ideal coating should have. The best method of applying these coatings and their long-term durability and resistance to leakage shall be assessed. The cost-effectiveness of various application methods shall be explored. This is a new RFP.

8. Horizontal Drilling Inmine Demonstrations

Objective: To demonstrate methane drainage from underground locations in very gassy mines in central Pennsylvania, specifically in the deep Freeport coalbed and the deep Upper Kittanning coalbed. Holes shall be drilled from advancing outside entries, safe underground piping systems shall be installed, and exhausters and compressors shall be installed on the surface. The gas will beutilized if practicable. This is a new RFP.

Ground Control

Program Objective: To conceive, develop, demonstrate, and transfer technology that will prevent mining accidents attributable to falls of ground, outbursts, and slope failures.

Premining Investigations

1. Determine Research Needs for Improving Ground Control Safety in Nonmetal, Stone, Sand, and Gravel Mine Accidents

Objective: To conduct an industrial engineering study to assess the characteristic patterns of mine accidents in the stone, sand, and gravel industry. Recommendations for ground control research projects most needed by the industry shall be made to the Bureau. This is a new RFP.

2. Safety Guidelines for Mining Near Surface Bodies of Water

Objective: To examine various safety parameters for mining near surface bodies of water, and develop criteria for reasonably and rapidly determining whether a particular body of water constitutes a hazard to mining and thus requires special mining plans. This is a new RFP.

3. Preparation of a Field Guide for the Identification of Rock Cores in the Northern Appalachian Coal Region

Objective: To produce a field guidebook for identification, description, and classification of cored mine roof rocks for engineers, geologists, and drillers working in the northern Appalachian coal regions. This project shall produce a guidebook similar to the one already completed for the rocks in southern West Virginia. This is a continuation of an ongoing effort.

4. Deep-Penetrating Borehole Geophysical Techniques

Objective: To develop a borehole geophysical technique to remotely sense and locate geologic features that are indicators of potentially hazardous zones or obstacles to future mine development. Work shall continue on development of a prototype borehole radar probe system to detect hazardous features remote from the borehole. This is a continuation of an ongoing effort.

5. Development of Between-Borehole Geophysical Techniques

Objective: To investigate and evaluate relevant cross-hole geophysical techniques, followed by selection, development, and testing of one of them for the purpose of determining geologic conditions between boreholes drilled in coal measure rocks. This is a new RFP.

6. Geologic and Engineering Data Acquisition for Underground Coal Mine Ground Control

Objective: To investigate the feasibility of establishing a permanent geological and engineering data repository for systematic acquisition of case history records and experience in coal mine ground control. The requirements of the data repository and methods and procedures for data collection, synthesis, storage, and retrieval shall be defined. Acquisition of the data base shall begin from a selected coal region. This is a continuation of an ongoing effort.

Selection of Mining Systems and Mine Opening Design

7. Feasibility Study of Stress Control Techniques--Application to Coal Mining Safety

Objective: To investigate the feasibility of using the recently developed stress control techniques as an alternative to roof bolting in underground coal mines. This project shall include computer modeling of mine entry configurations and field demonstration of stress control techniques in development of a deep longwall coal mine. This is a new RFP.

8. Single-Entry Systems for Longwall Mining

Objective: To design a single-entry system for retreat longwall coal mining at a selected site. The contractor shall review pertinent mine safety laws and regulations, select the mine site, conduct a geotechnical investigation of the selected site, and prepare a design for the entry system, including all equipment, entry configuration, ventilation plan, and roof control plan. This is a new RFP.

9. Longwall Mining Principles for Safely Working Steep Coal Seams

Objective: To analyze mining principles on which mechanized longwall mining of coal must be based to insure safe extraction of steeply pitching seams. Emphasis shall be placed on collection and evaluation of technical

information from foreign sources, and a comprehensive guide for safe extraction of steep coal seams in the United States shall be developed. This is a new RFP.

10. Demonstrate Underhand Mining Methods Safety

Objective: To develop an inherently safe, underhand stoping method to replace the cut-and-fill stoping method of metal mining in areas prone to rock burst hazards. The contractor shall assist the Bureau in-house project personnel in conducting an inmine demonstration of the underhand stoping method. This is a new RFP.

11. Automatic In Situ Shear Tester for Coal and Coal Measure Rock

Objective: To continue to develop automatic downhole shear test equipment for use from the ground surface to rapidly measure the shear strength of rock in situ at any depth in the periphery of vertical or inclined boreholes. This is a continuation of an ongoing effort.

12. Destressing in Advance of Mining

Objective: To demonstrate the effectiveness of advance destressing of an ore vein in prevention of rock bursts at an overhand cut-and-fill stope in the Coeur d'Alene mining district. Instrumentation and monitoring of the test stope shall continue, and finite-element model analysis shall be made to check theoretical results against actual measurements of stress change and closure of vein walls. This is a continuation of an ongoing effort.

Roof Support Systems

13. Determination of Optimum Roof Bolt Tension

Objective: To determine the optimum installation tension of mechanical roof bolts for effective roof control in underground coal mines. The program plan is being developed under an ongoing contract. It will consist of field, analytical, and laboratory studies. This is a new RFP.

14. Inmine Test of Hardened Washers Using Torque-Thrust Controls

Objective: To introduce a production-model roof bolting machine equipped with a torque-thrust control system developed under previous research contracts into underground coal mines, and to determine the effects of using hardened washers with mechanical roof bolts on the uniformity of bolt tension when the bolts are installed by this bolting machine. This is a new RFP.

15. Roof Support Mechanism Data Retrieval System

Objective: To create a readily retrievable data base of all currently available roof support information, including data on support mechanisms, performance, mechanical properties, installation procedures, testing criteria, technical literature, etc. This is a new RFP.

16. Mine Roof Presupport by Forepoling

Objective: To determine the state-of-the-art in mine roof presupport using forepoling, and to design a forepoling system suitable for trial in domestic underground coal mines. This project shall include a literature search, mine visits, computer analysis of various forepoling plans and roof reinforcement mechanisms, and preparation of detailed drawings and specifications for the required equipment. This is a new RFP.

17. Flexible Liner for use in an Advancing Tailgate

Objective: To design and demonstrate in a selected coal mine a flexible liner and backpacking system for ground support in an advancing tailgate of a newly developed layout of longwall retreat mining. The flexible liner will facilitate maintaining the tail entry, protect miners from roof falls, and provide an adequate ventilation system and fireproof escapeway. This is a continuation of an ongoing effort.

18. Full-Scale Model Test Roof Bolt System

Objective: To complete the full-scale roof bolt test facility that is being constructed at Spokane Mining Research Center, Spokane, Washington. This is a continuation of an ongoing effort.

19. Component Tests of Roof Bolt Systems

Objective: To continue to conduct laboratory testing of roof bolt performance on full-scale and reduced-scale models of simple concrete beams. The test data will be used as an input to the in-house research project "Modeling Roof Bolting System." This is a continuation of an ongoing effort.

Safe Support Installation and Protection at the Face

20. Design, Fabricate, and Test Lightweight Support Substitutes

Objective: To design, fabricate, and test superior lightweight substitutes for conventional timber and steel supports being used in coal mines. identification of candidate substitutes shall be made from the results of an ongoing contract. Both laboratory and inmine tests are required to evaluate performance characteristics of the prototype models. This is a new RFP.

21. New-Generation Roof Bolter

Objective: To develop preliminary designs of four to six roof bolting machines based on the new concepts that are being developed under an ongoing research contract. The new bolters will offer significant advantages over currently available bolting machines, and each of them shall be designed for a specific set of mining conditions. This is a new RFP.

22. Fabricate and Test a Remotely Controlled, High-Roof Bolting Machine for High-Roof Areas in Coal Mines

Objective: To build and field-test a prototype unit of the remotely controlled, high-roof bolting machine being designed under an ongoing contract. The machine will perform the functions of roof scaling, bolt-hole drilling, and bolt installation with the operator located in a protected location. This is a new RFP.

23. Construct and Test a Device for Installing Cement-Grouted Roof Bolts

Objective: To construct a permissible device mounted on a roof bolting machine to enable mixing and placing of inorgainc cement grouts into the drill hole before insertion of the bolt, based on the technical information obtained from the Bureau's in-house research project. The device must be small and powered by the hydraulic system of the bolting machine. It shall be tested in the laboratory and in a selected coal mine. This is a new RFP.

24. Development of a Pumpable Roof Bolt Machine

Objective: To modify the pumpable roof bolt placement machine assembled under a previous research contract and demonstrate the pumpable bolt system in a selected coal mine using the improved placement machine and a new bolt-resin mix that is being formulated under current in-house and contract research efforts. The improvements shall include new pumping system, capability to handle glass-reinforced polyester core, flexible shaft drill, capability to drill smaller holes, simplified resin handling, and reduced maintenance. This is a new RFP.

25. Improved Installation Equipment and Practices for Roof Trusses

Objective: To design, fabricate, and field-test an improved roof bolting machine that will enable efficient and safe installation of rod-type roof trusses in underground coal mines. This is a new RFP.

26. Design and Develop Standardized Controls on New Roof Bolting Machines

Objective: To design, develop, fabricate, and field-test a prototype of a standardized, simplified control system for all types of new roof bolting machines. The standardized control system should reduce potential hazards to bolting machine operators and increase productivity of roof bolting operations. This is a new RFP.

27. Development of Equipment for Placing Underground Concrete Support Walls

Objective: To develop new or improved equipment, methods, and materials for constructing concrete ground support systems in underground coal mines. The contract work shall include definition of equipment requirements, selection of an optimum system, and preparation of design specifications, drawings, and a cost estimate for construction of prototype equipment. This is a new RFP.

28. Temporary Face Support System

Objective: To build a mobile temporary roof support unit for use at the working face to insure safety in both continuous and conventional mining. The prototype unit to be built and field-tested during fiscal year 1979 is a carrier-and-emplacer unit that can place post-and-beam sets into the freshly excavated face area to support the mine roof temporarily until permanent roof bolting is done. This is a continuation of an ongoing effort.

29. Retreat Mining Support System

Objective: To demonstrate a mobile temporary roof support system consisting of a mobile roof support unit and a temporary breaker prop unit for use in typical room-and-pillar retreat mining. During fiscal year 1979 field demonstration of this system shall be conducted at a coal mine. This is a continuation of an ongoing effort.

30. Remote Drilling and Bolting System for Metal and Nonmetal Mining

Objective: To design, build, and field-test a remotely operated drilling and bolting system suitable for use in metal and nonmetal mines. The recent advances in rock bolting technology and bolting machine design made under the coal mine safety research program shall be used in designing the new system to meet the specific bolting requirements and mining conditions of metal and nonmetal mines. This project is expected to be completed in 3 years. This is a continuation of an ongoing effort.

31. Field Evaluation of Resin Bolt Installations

Objective: To conduct a follow-on field evaluation of a new instrumentation package that has been developed under an ongoing contract for determining the installation quality of full-column resin bolts. Tests shall be conducted at two coal mines to evaluate the performance and reliability of the instrumentation package. This is a new RFP.

Hazard Detection and Monitoring Systems

32. Testing and Demonstrating of Roof Bolter Instrumentation for Detecting Hazardous Roof

Objective: To test and demonstrate in selected mine sites the instrumentation for detecting hazardous roof conditions by using roof bolting machine parameters that will be recommended as the result of an ongoing contract. The instrumentation should give roof bolting machine operators an instantaneous feedback on roof stability. This is a new RFP.

33. Field Trials of a Microseismic Roof Fall Warning System

Objective: To inmine-test the commercial prototypes of an automatic microseismic roof fall warning system that are under development by the Bureau's in-house effort. A performance base using natural small-scale roof falls as an input will be established for the prototypes. This is a new RFP.

34. High-Speed Drill Probe To Detect Abandoned Underground Workings

Objective: To design, fabricate, and demonstrate a portable, high-speed drill probe to detect abandoned workings from the confined space of active working faces in underground anthracite mines. This is a new RFP.

35. Development and Trials of a Commercially Practical Resistivity Roof Fall Warning System

Objective: To develop a prototype unit of a commercially practical, resistivity roof fall warning system based on the results of an ongoing field experiment. The prototype unit will be tested for its practicability and reliability in selected coal mines. This is a new RFP.

36. Fabricate and Demonstrate Best Student-Designed Roof-Failure Indicators

Objective: To encourage students' interest and participation in coal mine safety research, this project is specifically aimed at providing funds to selected universities for fabrication and testing of mine roof failure monitoring devices that will be designed by students in their engineering design courses. The universities shall provide adequate instructions to the participating students and bear all necessary costs for the design phase. This is a continuation of an ongoing effort.

37. Geophysical Hazard Detection From the Working Face

Objective: To develop an operational system using geophysical techniques to delineate abandoned mine workings, water-filled zones, and gas or oil wells from the working face of an operating coal mine. The system parameters and component parts shall be designed and specified based on the results of previous studies. This is a continuation of an ongoing effort.

38. Radar Soundings at the Working Face for Hazard Detection

Objective: To improve previously developed radar sounding techniques and equipment for detection of abandoned workings and cased and uncased oil wells from the working face of an operating coal mine. More field measurements shall be conducted at selected test mines for improvements in instrumentation and data enhancement. This is a continuation of an ongoing effort.

39. Develop Underground Model of Magnetostrictive Roof Bolt Tension Indicator

Objective: To develop and evaluate a permissible model of the previously developed magnetostrictive roof-bolt tension indicator for use in underground coal mines. An alternative design of the device shall also be investigated. This is a continuation of an ongoing effort.

Mine Waste Stability

40. Compaction Criteria for Coal Waste Embankments

Objective: To determine by field tests the compaction characteristics of coal waste material when densified by various types of commercial compacting equipment, and to determine the tendencies for spontaneous combustion of the compacted coal waste. The test results shall be used to develop compaction criteria for construction of coal waste embankments. This is a new RFP.

41. Safety Characteristics of Drainage Structures

Objective: To investigate and demonstrate by physical models the flow phenomena and characteristics in the culverts and spillways of various types of mine waste impoundments. The results will help coal mine safety personnel of MSHA and the mining industry to understand the complex hydraulic conditions and performance of mine waste impoundment drainage structures. This is a new RFP.

42. Coal Mine Waste Dewatering

Objective: To investigate current practices of transporting and disposing the fine waste material discharged from coal washing plants, and to design specific techniques for coal sludge dewatering that can be integrated into existing coal processing systems to eliminate the need for surface impoundment of coal sludge. Cost analysis of the dewatering methods shall also be conducted. This is a new RFP.

43. Centrifuge Model Testing of a Coal Waste Embankment

Objective: To obtain more data on displacements, pore pressures, and slope stability of coal waste embankments using centrifuge testing of models to simulate gravitational loading conditions. Models shall be constructed from sample materials collected from field embankments, and the test results shall be analyzed to determine safety factors for embankment design and construction. This is a continuation of an ongoing effort.

44. Feasibility Study--Microseismic Determination of Waste Dam Stability

Objective: To conduct a preliminary study of currently available microseismic equipment to determine its applicability to monitoring stability of mine waste dams. One type of equipment shall be selected for field evaluation at two test sites, and the test data shall be analyzed for determination of the future course of research and development. This is a new RFP.

Industrial-Type Hazards

Program Objectives: To (1) limit the possibility of human error through training and worker-machine interfacing, (2) improve equipment design and control, (3) detect and prevent failures of electric circuitry and hardware, (4) provide adequate lighting in working areas, (5) insure continuous and

reliable communication between all underground and surface mine personnel, while providing continuous surveillance of the mine environment, and (6) improve safety in haulage and materials handling operations.

Human Factors

1. Development of Requisite Support for the Lincoln Training System

Objective: To design an author support system for developing course material for the Lincoln Training System. A new microfiche generation system is being developed that will accommodate the production and reproduction of fiche generated by six authors simultaneously. Lincoln personnel will assist the Bureau in transferring this system to the mining industry. This is a continuation of an ongoing effort.

2. Refinement of Shuttle Car Training System

Objective: To design, fabricate, and validate a second-generation shuttle car training system. The training system shall be developed via improvements and modifications to the prototype system previously developed under separate contract. The training system shall provide the essential skills and knowledge to new operators of shuttle cars to insure safe and efficient operation. This is a new RFP.

3. Development and Fabrication of a Continuous Miner Training System

Objective: To continue the design, development, and validation of a training system to provide the requisite skills and knowledge to new operators of continuous miners. This effort shall be used to refine the components of the training system developed in a fiscal year 1977 contract. The hardware design shall be refined and updated if necessary. The course materials shall be reviewed and rewritten as necessary. This is a continuation of an ongoing effort.

4. Research and Development of New-Miner Orientation Programs

Objective: To develop new-miner orientation programs consistent with MSHA regulations on training as required in Public Law 95-164. The program deals with meeting training requirements of new miners and retraining of older miners. This is a continuation of an ongoing effort.

5. Development of Materials and Strategies for Preshift Equipment Inspection

Objective: To analyze the potential increase in equipment operator safety that may be realized through a better understanding of the purpose and function of safety-related equipment on mobile equipment and of preshift mechanical inspection procedures. The mobile equipment to be addressed on this program includes tractors, scrapers, motor graders, dozers, front-end loaders, haulers, and pipelayers. This is a continuation of an ongoing effort.

6. Biomechanics of Low Coal

Objective: To review equipment used in coal mines by the miners (may include anything from personal equipment to mining machines) in order to determine if the equipment is suitable for this particular environment and if it presents a hazard. Efforts shall then be made to determine whether a new design or change in methodology to alleviate the situation is feasible. This is a new RFP.

7. Design, Development, and Validation of Training Systems for Roof Bolting Equipment Operators

Objective: To continue the design, development, and validation of a training system to provide the requisite skills and knowledge to new operators of roof bolting equipment. Based upon preliminary data received from the upcoming validation program, the program of instruction shall be refined and updated. The specific goal is to provide new bolting equipment operators with necessary skills to decrease the occurrence of injuries during the initial months of equipment operation. This is a continuation of an ongoing effort.

8. Relationship of Supervisory Safety Training to the Safety Behavior of Coal Mine Personnel

Objective: To define accident-related work behavior in underground coal mines and to develop, implement, and validate a supervisory training program for behavioral modifications through the use of applied behavior management techniques. Phase 1 shall consist of analyzing the training needs of management and supervisory personnel. Phase 2 shall consist of the development of training materials, refinement of these materials, training of supervisors, and assessment of the training effectiveness. This is a continuation of an ongoing effort.

9. Study To Determine the Feasibility of Person Trip Training

Objective: To investigate various training media for their ability to be adapted to mine safety training during rail person trips to and from the working section. A demonstration program for the adaptation of present training material to the training situation shall be developed and implemented. The selection of media would be based upon the quality of instruction within the environmental parameters, the investment and variable cost of adapting present training material to person trip situations, maintenance costs, and user acceptance of the system chosen. This is a continuation of an ongoing effort.

10. Haulage Truck Training System

Objective: To continue with the design, development, and implementation of a haulage truck training system that would satisfy the training requirements of haulage truck operators. This project shall design and develop the hardware and software necessary to implement the training system proposed during the validation period, which shall be followed by report distribution and technology transfer seminars. This is a continuation of an ongoing effort.

11. Investigation of Fires in the Mining Industry for Determination of Training Requirements and Development of Training Programs

Objective: To ascertain the frequency of incipient fires in various mine settings, to determine the etiology of the fires, and to analyze the tasks involved in extinguishing the fires. Phase 1 shall deal with these objectives. Phase 2 shall be directed toward developing training programs in underground coal mines, underground metal and nonmetal mines, and all types of surface mines. The training program shall be based on task analyses for extinguishment. This is a new RFP.

12. Evaluation of Delivery Systems for Effective Training

Objective: To increase initial learning rates by 25 percent through selection and use of the proper delivery system. The proposed effort shall be able to quantitatively verify an individual's ability to understand various types and amount of course material as presented by selected types of training media. Efforts shall also be directed toward the determination of criteria for delivering certain types of course material. Such criteria shall be based upon the evaluation effort completed and correlated to the effectiveness of the training media in modifying behavior through improved understanding. This is a new RFP.

13. Development of a Front-End-Loader Training System

Objective: To design, develop, validate, and implement a front-end-loader training system that would satisfy the training requirements of front-end operators. The initial effort of the project shall be to formulate specifications for the functional requirements of a front-end-loader training system. A system that meets these requirements shall be designed and implemented through the initial training equipment demonstration during a validation period. This is a new RFP.

14. Improvement of On-Job-Training Procedures Through Utilization of Modeling, Initiative, and Vicarious Learning Techniques

Objective: To reduce accident-producing behavior by improving the initial learning situation through utilization of modeling, initiative, and vicarious learning techniques. Because extremely high accident frequencies are associated with new task acquisition, this project should significantly reduce accidents through training. The project shall consist of providing expert models for miners who are acquiring new work tasks. These models will serve as discriminative stimuli for various task elements and will provide error-free examples for initiative learning. This is a new RFP.

15. Investigation and Development of Training Programs for Shaft-Sinking Personnel

Objective: To develop, implement, and validate training programs for shaft-sinking personnel. Using the recommendations provided under a fiscal year 1978 contract, "Training Requirements for Shaft Sinking Personnel," a

program of instruction and training strategy will be devised and approved, and the training package(s) will eventually be implemented. This is a continuation of an ongoing effort.

16. Develop Training Systems for Mine Hoist Operators

Objective: To review existing hoist operations and to present training practices, to perform a task analysis of hoist operator responsibilities, and to develop, implement, and validate a hoist operator training system. Based on the preliminary data received from the upcoming validation program, the program of instruction shall be refined and updated. This is a continuation of an ongoing effort.

17. A Study of Human Engineering and Organizational Development in Noncoal Mines

Objective: To define specific human factor problem areas in the underground noncoal mining industry that are susceptible to research solution and to reduce accidents associated with human error through application of organizational development principles. Once the human factor problems have been identified, a feasibility study to determine if an organizational development program is possible shall commence. A 3-year development effort shall then attempt to demonstrate that as efficiency is increased the accident rate is reduced. This is a continuation of an ongoing effort.

18. Study To Determine the Manpower and Training Needs of the Coal Mining Industry

Objective: The House of Representatives Committee on Appropriations for the Department of the Interior in its report to the 95th Congress requested that:

> the Bureau, in conjunction with the Department of Energy, undertake a comprehensive study of the training needs of the coal industry in cooperation with the industrial and academic sectors and other government agencies. The study, which should be completed in FY 1979, should recommend a training program to be undertaken jointly by the government and industry and include an estimate of cost, manpower, and facility needs.

This project is a response to this urgent congressional request. The Bureau of Mines under a contract to John Short and Associates is sponsoring a study entitled "Forecast of Employment and Training in the Coal, Metal and Nonmetal Mining Industries." Parts of this study are responsive to the Appropriations Committee request. This is a continuation of an ongoing effort.

Electrical

19. Environment Test Criteria for the Acceptability of Mine Instrumentation

Objective: To develop criteria for the purpose of testing the suitability of electrical instruments and apparatus for mining environments as related to dust, shock, vibration, humidity, temperature, and other tests. Some collection of data on the actual mine environment may be required. This is a new RFP.

20. Splicing Three-Conductor, Round Shuttle Car Cables

Objective: To examine current splicing practices for three-conductor, round shuttle car electrical trailing cables. Improved splicing techniques and associated prototype tools shall be pursued as necessary. New or improved techniques shall be field-tested. This is a new RFP.

21. Criteria for Specifying Ground Fault Protective Settings for Low-, Medium-, and High-Voltage Resistance-Grounded Circuits

Objective: To establish criteria for maximum ground fault relay settings and maximum safe time delay requirements for protection of resistance-grounded circuits, particularly for trailing cables. Guidelines shall be prepared. This is a new RFP.

22. Plug- and Receptacle-Type Connectors

Objective: To review the design and test requirements for plug- and receptacle-type connectors for completeness. If additional requirements are necessary, they shall be developed, and tests shall be conducted to verify that plug- and receptacle-type connectors meet these criteria. This is a new RFP.

23. Cable Handling and Damage Protection at Surface Mines

Objective: To determine safe and efficient means of manning and handling shielded high-voltage trailing cables of surface mine equipment. Recommendations shall include maximum lengths of cable, minimum bending radius, and methods of attaching cable. This is a new RFP.

24. Evaluation of Control Circuits and Protective Criteria

Objective: To examine the reliability of various types of control and protective circuits. Mine hoist circuits and thyristor power supplies shall be considered. This is a new RFP.

25. Design Criteria for Substations, Load Centers, and Components

Objective: To develop cirteria for specifying the minimum protective device requirements for substations and load centers. The criteria shall also recommend standards that various components must meet. This is a new RFP.

26. Guidelines for Liquid-Filled, Explosion-Proof Enclosures

Objective: To develop guidelines for testing and accepting liquids proposed for use in explosion-proof enclosures. The tests developed shall include such items as dielectric strengths and arc-decomposition products. This is a new RFP.

27. Equipment and Enclosures Energized at Over 1,000 Volts

Objective: To evaluate present test and design criteria for enclosures and motors up to and including 4,160 volts. If present criteria are not adequate, additional criteria for acceptance of high-voltage explosion-proof equipment shall be developed. This is a new RFP.

28. Classification of Coal Preparation Plants

Objective: To develop comprehensive guidelines for classifying a coal preparation plant. The principal task will involve identification of a method of quantifying the amount of water required to be added to the cleaning process to classify the process as nonhazardous. This is a new RFP.

29. Survey of Electrical Equipment Used in Mining

Objective: To determine the size, type, age, settings, and other information about electrical equipment used in mining. In addition, special electrical requirements of oil shale and trona mines shall be identified. This is a new RFP.

30. Recommendations for Electrical Requirements in Surface Facilities

Objective: To survey the electrical practices presently being used in the surface facilities of metal and nonmetal mines. If unsafe practices are identified, recommendations for safe and efficient practices shall be developed. One item to be considered shall be electrically powered dredges. This is a new RFP.

31. Application Notes on Mine Electric Power Systems

Objective: To prepare application notes based on Bureau of Mines research on electric power system devices and methods. Notes will be prepared in a standard format, through in-depth interviews with Bureau principal investigators, study of final reports, etc. They shall be disseminated to industry maintenance and operating engineers. This is a continuation of an ongoing effort.

32. Development of Tests and Criteria To Evaluate Grounding Systems

Objective: To evaluate mine grounding systems, optimize bed construction, develop analytical techniques, and evaluate grounding components. Visits to mines to make measurements and field test equipment shall continue. Optimal methods of ground bed configuration shall be finalized, and evaluation of components used in construction shall continue. This is a continuation of an ongoing effort.

33. Time-Domain Reflectometry Microcomputer Testing

Objective: To improve cable fault locators based on field results. Field test units shall be modified as necessary, and their microcomputer programs shall be revised. New field tests shall be performed. This is a continuation of an ongoing effort.

34. Transients Protection, Reliability Investigation, and Safety Testing of Mine Electrical Power Systems

Objective: To improve methods of safety inspection and maintenance scheduling through innovative devices and techniques. Newly available techniques and devices shall be evaluated for their suitability as safety inspection tools. Field tests shall be performed to assess reliability of electrical system components and to set recommended maintenance schedules This is a continuation of an ongoing effort.

35. Inmine Demonstration of Discriminating Circuit Breaker System

Objective: To demonstrate the discriminating circuit breaker system in a coal mine. The demonstration shall check the effectiveness of the fault detection system under actual mining conditions. This is a continuation of an ongoing effort.

36. Mine Trailing Cables and Cable Splices

Objective: To improve the safety of electrical cables by conducting laboratory and field studies on methods of handling, repairing, and using cables. Evaluation of cable and splice materials and construction for possible improvements shall be included. This is a continuation of an ongoing effort.

Equipment

37. Development and Assessment of New and Existing Canopy Technology To Lower Coal Seams

Objective: To evaluate the application of previously developed as well as new canopy design technology to lower seam heights. This technology and other concepts developed by manufacturers and coal companies shall be evaluated first through mockup fabrication and finally through inmine operation. Human factors engineering shall be included in all designs. This is a continuation of an ongoing effort.

38. Second Generation of Stability Indicators for Front-End Loaders

Objective: To develop and demonstrate improved alternative designs of a stability-indicating device for front-end loaders. The performance, related maintenance, and costs shall be evaluated during inmine testing. This is a new RFP.

39. Improved Rubber-Tired, Off-Highway Vehicle Steering Systems

Objective: To develop improvements as necessary in the steering of equipment, using the results of the completed contract "Steering System Survey for Surface Mining Equipment." This is a new RFP.

40. Design of a Braking System Performance Evaluation Simulator

Objective: To investigate what type of testing system is needed to evaluate a braking system for compliance with proposed Mine Safety and Health Administration regulations. This system must have the capability of testing the brake system without being mounted on the actual mining equipment. This is a new RFP.

41. Improved Access-Egress Systems for Large Front-End Loaders

Objective: To evaluate the safety hazards related to ladders on large front-end loaders. Improved ladders shall then be developed and demonstrated to improve access and emergency egress systems for this type of vehicle. This is a new RFP.

42. Develop and Test Radar-Transponder Anticollision Systems for Large Mining Equipment

Objective: To explore the use of radar transponder technology in preventing the collision of large surface mine vehicles. Work shall include the design, fabrication, bench testing, and on-vehicle testing of this type of system in a mining environment. This is a new RFP.

43. Off-Highway Vehicle Passive Restraint System

Objective: To examine current seat belt systems used on mining equipment and determine their shortcomings. A new restraint system shall then be developed or adapted from current technology and demonstrated on several types of equipment. This is a new RFP.

44. Improved Access-Egress Systems for Large-Tracked Machines

Objective: To evaluate the safety hazards related to ladders on large-tracked machines, primarily dozers. Improved access and emergency egress systems shall then be developed and demonstrated. This is a new RFP.

45. Improved Backup-Warning Systems

Objective: To develop a simple, low-cost backup-alarm system that can survive in the harsh mining environment and yet alert people to the reverse movement of mining equipment. This is a new RFP.

46. Improved Access-Egress Systems for Loading Shovels

Objective: To evaluate the safety hazards related to ladders on loading shovels. Improved access and emergency egress systems shall then be developed and demonstrated. This is a new RFP.

47. Develop and Demonstrate Improved Truck Ladders

Objective: To evaluate the safety hazards of ladders on surface mining mobile equipment, and then develop and demonstrate improved ladder designs for large haulage vehicles. This is a continuation of an ongoing effort.

48. Underground Equipment Modifications for Increased Safety

Objective: To modify methods, operating procedures, and/or equipment used in underground mines to make operations safer. Existing mining systems shall be evaluated in phase 1 for unsafe or problem equipment, and machinery and recommended corrective action shall be developed in phase 2. This is a new RFP.

49. Surface Equipment Modifications for Increased Safety

Objective: The Bureau seeks a cooperator who can represent equipment manufacturers in a joint technical research program. The program will relate to safety problems in surface mining and will identify what is needed to solve these problems. Specific objectives will be developed during the program. This is a new RFP.

50. Determination of Criteria for Rollover Protective Structures (ROP's) for Large Mining Equipment

Objective: To determine through actual testing if SAE J1040 ROP's criteria are adequate for large mining equipment. Front-end loaders in the 200,000- to 400,000-pound weight range shall be used in the testing program. This is a new RFP.

Illumination

51. Illumination of Surface Mining Equipment

Objective: To demonstrate the feasibility of providing adequate lighting in surface mines. Illumination systems for mobile mining equipment shall be designed to meet the requirements of the proposed regulations for illumination of surface mines. The systems shall be implemented and tested in operating mines. This is a new RFP.

52. Investigation of Special Problem Areas Associated With Illumination of Surface-Mining Equipment

Objective: To develop specialized power supplies and other devices needed for the illumination systems of some surface mining equipment. The

resulting hardware shall be evaluated by inmine demonstrations. This is a new RFP.

53. Illumination of Specialized Mining Equipment

Objective: To design and install lighting systems on mining machinery that is particularly difficult to illuminate. This technical assistance shall be given to MSHA and the industry through inmine demonstrations with specialized machines such as low-coal, load-haul-dump (LHD) equipment that are not widely used but must be illuminated. This is a new RFP.

54. Further Implementation of Computer Simulation Evaluation of Mine Illumination Systems

Objective: To develop additional software and hardware to model mining machines, entries, and luminaires. It will provide for modeling of remaining available luminaires, purchasing the necessary software, and training MSHA and Bureau of Mines personnel to operate the system. This is a new RFP.

55. Factory Integration of Illumination Systems Into Mining Machinery

Objective: To redesign a presently produced conventional or continuous mining machine to accept a permissible lighting system as an integral component. The redesigned machine shall be evaluated in operating coal mines to demonstrate the feasibility of protecting the lighting system from external forces. This is a new RFP.

56. Handbook of Guidelines for Installing Acceptable Illumination Systems on Surface Mobile Equipment

Objective: To develop a handbook for the installation of acceptable illumination systems on commonly used surface mobile equipment. The published manual will assist industry in complying with the proposed requirements for illumination of surface mining equipment. This is a new RFP.

57. Refinement and Demonstration of Specialized Power Supplies for Mine Illumination Systems

Objective: To develop and demonstrate specialized power supplies for coal mine illumination systems. Practical hardware to enable illumination of machines that are operated on power sources other than alternating current or 300-volt direct current shall be provided. This is a new RFP.

58. Evaluation of Illumination Requirements in Metal and Nonmetal Mines

Objective: To define worker tasks and task locations in metal and nonmetal underground mines. Existing data shall be compiled, and additional pertinent information shall be collected on work locations, environments, and task descriptions. This is a new RFP.

Nonemergency Communications

59. Underground Blasting Hazards at Medium Frequency

Objective: To determine the hazards associated with medium-frequency (MF) radio transmission underground and electric blasting and recommend safe practice. The investigation will use propagation data and cap-sensitivity data already obtained by the Bureau of Mines; following limited inmine testing, guidelines shall be developed on safe distances between blasting circuits and signal-carrying wires in the frequency range of 300 kHz. This is a new RFP.

60. RF Effects on Solid State Controls of Mine Machinery

Objective: To determine the magnitudes and frequencies of radio frequency (RF) energy that adversely affect the use of solid state controls in mines. Controls and regulators shall then be subjected to various magnitudes and frequencies of RF energy to determine what effect the RF energy has on their performance. This is a new RFP.

61. Demonstration of MF Wireless Radio

Objective: To conduct a 1-year evaluation of MF mine wireless radio technology and hardware under operational conditions. Hardware shall be constructed from specifications determined under a previous contract. The Bureau will enter into a cooperative agreement with a coal mine for inmine evaluation. This is a new RFP.

62. MF Leaky Feeder Communication System

Objective: To evaluate and demonstrate the effectiveness of a leaky feeder system at MF. The program will evaluate present MF leaky feeder cables and demonstrate the operation of MF cables in an operating mine in conjunction with Bureau-developed MF equipment. This is a new RFP.

63. Inground Communication System

Objective: To study a communication system that utilizes a cable buried in the floor of the mine. The work shall cover the design specification, operational parameters, and cost of installation and maintenance. This is a new RFP.

64. Characteristics of Data Communication Channels Underground

Objective: To characterize communication channels available underground, such as telephone lines and MF coupled to mine wiring, in terms of transmission performance. The project shall cover frequencies extending from baseband to about 1 mHz, measuring bandwidth and noise per channel. This is a new RFP.

65. Demonstration of Whole-Mine Monitoring and Control

Objective: To demonstrate an integrated communication, monitoring, and control system for an extended time and determine the overall benefits, costs, and problems of such a system. The project includes obtaining a cooperative mine, designing the monitoring and control system, selecting and procuring hardware, and installing and evaluating the system. The duration of the project will be about 3 years. This is a new RFP.

66. Lucerne Mine Communication and Monitoring

Objective: To develop, fabricate, and test the interface hardware to integrate present wire systems with a UHF radio system. This is a new RFP.

67. Integrated Pagerphone System

Objective: To develop an improved pagerphone system that incorporates postdisaster communications and electromagnetic paging. Existing systems shall be reviewed, and an integrated system shall be designed. The system shall be evaluated in an operating mine. This is a new RFP.

68. Mine Communication Training Program

Objective: To develop a program for training mine maintenance personnel, State and Federal inspectors, and other industry and Government personnel in the theory and practice of mine communication techniques. Work will include development of various training aids, such as an instructor's guide, student outline and workbook, manual of laboratory experiments, laboratory training apparatus, modern picture films, slides, graphical displays, and charts. This is a new RFP.

69. Demonstration Guidelines for Mine Telephone and Trolley Phone

Objective: To demonstrate to the mining industry methods of implementing certain guidelines for mine communication systems developed for the Bureau under previous contracts. The project shall be carried out in a cooperating coal mine with a poor performance communication system. The system shall be surveyed and upgraded in accordance with the guidelines. The system shall be demonstrated to all interested parties. This is a new RFP.

70. Evaluation of the Effectiveness of Sunshine Mine Communication and Monitoring System

Objective: To evaluate the communication and monitoring installation for design efficiency and operational effectiveness relative to safety and productivity. The operational expectancy of the system shall be compared with actual performance and effectiveness. Improvements shall be recommended to obtain operational effectiveness and the greatest utility and cost benefit to the mining industry. This is a new RFP.

71. Demonstrate Medium-Frequency Communications System in a Metal or Nonmetal Mine

Objective: To design, procure, install, and conduct a 1-year demonstration of a whole-mine communication system utilizing equipment operating at MF for communications to and between personnel and vehicles and the surface of a cooperating metal or nonmetal mine. This is a new RFP.

72. Evaluation of Effectiveness of Black River Mine Communication and Monitoring System

Objective: To evaluate the communication and monitoring installation for design efficiency and operational effectiveness relative to safety and productivity. The operational expectancy of the system shall be compared with actual performance and effectiveness. Improvements shall be recommended to attain operational effectiveness and greatest utility and cost benefit to the mining industry. This is a new RFP.

73. Hoist Signal and Display System

Objective: To design, fabricate, and demonstrate a hoist signal monitor and display system that will automatically receive hoist signals from various mine levels and present these signals on a display for the convenience of the hoist operator in order to improve the safety and efficiency of the hoist operation. This is a new RFP.

74. Automatic System To Monitor Vehicle Location

Objective: To determine requirements, design hardware, fabricate hardware, install hardware, and demonstrate a system that will monitor the location of a vehicle operating in an underground metal or nonmetal mine. This is a new RFP.

75. Minewide Test of West Virginia University Monitoring Concept

Objective: To install in an operating coal mine a minewide monitoring system based on concepts previously advocated and tested. The system shall be maintained and evaluated. New components shall be designed incorporating microprocessors in the remote monitoring station in order to make a system that is both modular and more flexible. This is a continuation of an ongoing effort.

76. Analytical Studies of Electromagnetic (EM) Fields in Mine Environments

Objective: To develop theoretical models for EM fields in conductive media including propagation of waves in tunnels with and without conductors, properties of leaky feeders in tunnels, transmission loss characteristics of mine overburdens, and diagnostic properties of fields in wire ropes. This is a continuation of an ongoing effort.

Haulage and Materials Handling

77. Hoisting System Components Selection and Guidelines

Objective: To critically evaluate the regulations on hoisting system components as drums, brakes, guides, rope terminations, sheaves, drives, and instruments. A program shall be developed to correct deficiencies where they are noted. As the final product, a guide shall be developed for the selection of hoisting components, and existing MSHA regulations on hoisting components shall be verified. This is a new RFP.

78. Deep-Shaft Wire Rope Practices

Objective: To review wire rope design factors for deep mines emphasizing all aspects of wire rope mechanics beginning with unspooling of the drum, the effect of fleet angle, the placement of the sheave, the sheave diameter, and the hoisting distances involved. On the basis of analytical mechanics, the effects of rope twist, rope vibration, and rope dynamics during hoisting and the interaction between these factors shall be determined. This is a new RFP.

79. Development of Wire Rope Retirement Criteria

Objective: To determine how easily measured criteria such as the number of broken wires per lay length and the percent of original wire rope diameter affect the breaking strength of wire rope used in mine hoists. This is a new RFP.

80. Develop Hoisting Component Compatibility

Objective: To determine one optimum sheave diameter-hoist rope diameter ratio for rope diameters ranging from 7/8 to 2-1/2 inches for rope constructions commonly used in mining. The test environment shall be correlated to actual mining conditions; that is, rope, after bending around the test sheave, shall be allowed to cool to ambient temperature for a period of time equivalent to that of a realistic hoisting cycle before being bent around a sheave again. The temperature raise in the rope during testing shall be measured to determine its effect on wire rope endurance. This is a new RFP.

81. Systems for Handling Supplies in Underground Coal Mines

Objective: To design, construct, implement, and evaluate a system for the mechanical handling of supplies in underground coal mines, in order to reduce the injury rate and the time spent in handling supplies manually. Industrial engineering studies shall be utilized to define and justify the proposed system through accident and cost reduction considerations. An existing mining machine shall be modified to perform as a forklift, and a total materials handling system shall be defined and implemented in an operating mine. Accident rates and costs shall be maintained and utilized to evaluate the system. This is a new RFP.

82. Haulroad Berm, Guardrail, and Sign Design Study and Demonstration

Objective: To determine the kind, size, and construction of berms, guardrails, or a combination of both, for mine haulroads to be effective in controlling runaways or runoffs of mobile haulage vehicles of any size. The environmental effect, cost effectiveness, and safety impact of such construction shall be evaluated. A realistic approach to safety for mine haulroad use shall be recommended. Effective signing (road sign) guidelines shall be developed for mine haulroads. This is a new RFP.

83. Arrestment Devices for Shaft and Slope Mines

Objective: To test Sunshine mine safety dog designs to (1) determine their capability in meeting existing MSHA specifications; (2) determine the effect of installation and maintenance performance, (3) define retirement criteria for safety dogs and guides, (4) define the design criteria for an acceptable system (safety dogs, cross-heads, cages and skips, guides, guide attachments, etc.). This is a new RFP.

84. Development of Low-"G" Hoist Arrestment Devices

Objective: To develop and verify the performance of consistent, low-"g" arrestment devices including both vertical- and inclined-shaft conveyances. Existing devices shall be studied to define parameters that control the consistency and level of deceleration forces. New devices shall be built, laboratory-tested, and verified by free-fall tests. This is a new RFP.

Postdisaster

Program Objectives: To develop technology that will (1) enable survivors of a mine disaster to escape from the mine or to continue to survive while awaiting rescue by providing protection against toxic and/or oxygen-deficient atmospheres, (2) aid in the location of miners trapped underground, using seismic and electromagnetic means of communication, and (3) facilitate post-disaster rescue and recovery operations through surface monitoring of conditions underground, emergency communications, and mechanized transport and life support equipment for mine reentry and rescue operations.

Survival

1. Improved Oxygen Sources for Breathing Apparatus

Objective: To attempt a synthesis of pure metal superoxides. Several methods shall be examined, including reaction of metal salts with potassium superoxide, reactions of metal hydroxide, solvent extraction techniques for purification, and electrochemical techniques. Physical and chemical properties (reaction with CO_2 and water, decomposition temperature, etc.) of purified metal superoxides shall be studied. This is a continuation of an ongoing effort.

2. Physiological Responses of Miners

Objective: To quantitatively evaluate (1) the physiologic responses of miners to the demands brought about by emergency conditions, (2) the biophysical interaction between the miner and the prevailing environmental conditions during emergency, and (3) physiologic metabolic responses of rescue team members, including studies of fatigue when working for longer than 2 hours, effect of weight and breathing resistance of breathing apparatus on wearers, effect of inhalation of hot air, and effectiveness of cooling garments to relieve heat stress during rescue missions. This is a continuation of an ongoing effort.

3. Breathing Apparatus Person Tests

Objective: To test current breathing apparatus to determine the ability of these devices to meet newly developed person tests prescribed in 30 CFR 11. Tests shall also be performed to determine the effect of positive-pressure breathing apparatus. This is a new RFP.

4. Compressed-O_2 Self-Rescuer

Objective: To develop a 1-hour compressed-oxygen self-rescuer, comparable in size and weight to an available O_2 self-rescuer. This is a new RFP.

5. Physiological Response With Travel Speeds

Objective: To determine the actual physiological stress of persons traveling at various speeds in mine passage ways 30 to 72 inches in height. This is a new RFP.

Communications

6. Autodetection Algorithm for MSHA's Seismic Location System

Objective: To develop an autodetection algorithm for use with MSHA's seismic location system. The algorithm shall identify potential seismic signals generated by trapped miners by use of advanced data-processing techniques, determine time delays between first-break seismic events, and enter these data automatically into a refined location program. This is a new RFP.

7. Radio Section Phone

Objective: To provide transmitters that can be placed strategically in the mine at locations readily accessible by a miner after a disaster. Each transmitter shall be encoded to send a signal that identifies its location. This approach will avoid elaborate search procedures and will take advantage of medium-frequency transmission. This is a new RFP.

8. Theoretical Investigation of Seismic Waves Generated in Coal Mines

Objective: To study the feasibility of inmine seismic monitoring, to outline its application in detecting and locating trapped miners, and to determine if inside-mine monitoring has any significant advantages over surface seismic monitoring. Signal detection by inmine implanted geophones shall be investigated. This is a continuation of an ongoing effort.

9. Medium-Frequency Trapped-Miner Communication System With Voice Repeater

Objective: To develop an MF and VF repeater that will allow inmine MF communication systems to communicate to surface by way of a VF transmission and, in the reverse, allow surface-to-underground mine communications. This is a new RFP.

10. Integrated Packaging of Emergency Communication System

Objective: To develop a package that incorporates the trapped-miner transmitter-receiver with the lamp battery. This is a new RFP.

Rescue and Mine Reopening

11. Gas-Sampling Line Dehydrator-Condenser

Objective: To develop a gas-sampling line dehydrator-condenser for use during mine emergency situations where gas samples are drawn of mine atmospheres on a 24-hour basis. The condenser shall be tested during cold weather conditions, because line blockages result from condensation and freezing of water vapor contained within the samples. This is a new RFP.

12. Low-Temperature Evaluation of Rescue Breathing Apparatus

Objective: To test currently used rescue breathing apparatus (RBA) in a controlled environment of -29° C in order to determine what operational problems may occur during mine rescue and recovery work in extreme cold. RBA's are currently approved only for use above 0° C. This is a new RFP.

Systems Engineering

Program Objectives: To develop mathematical models for evaluating the impact of specific technological improvements or inadequacies on the total mining operation and identifying problems whose solution would provide the greatest health and safety benefit. To operate and maintain underground research and test facilities for use in testing and demonstrating new procedures and equipment, before they are field-tested in commercial mines. To participate in contract development and in the formulation of mine health and safety standards.

Systems Analysis

1. Evaluation Assessment of the Impact of MSHA Enforcement Activity on Coal Mine Safety Profiles

Objective: To determine the feasibility of conducting an evaluation of MSHA enforcement activities and, if feasible, to implement the evaluation effort with the basic objective of improving the delivery mix of MSHA services to impact more positively on the safety profile of domestic mines. This is a continuation of an ongoing effort.

2. Cost Benefit of Applied Health and Safety R & D

Objective: To quantify the extent to which hazards have been reduced by the utilization of health and safety R & D research and equate this into economic terms. A return on the investment in favorable R & D applications through reduced insurance costs (property damage and/or body injury) or uninsured losses shall be projected. This is a new RFP.

3. Evaluative Assessment of Health and Safety Research Subprogram Effectiveness

Objective: To study the subprograms of the Bureau's Health and Safety Research Program and assess the effectiveness of each subprogram in terms of hazards reduced and injuries prevented. Guidance shall be provided to redirect subprogram research efforts to effect hazard reduction and injury prevention. Subprogram structure shall be assessed, and recommendations shall be made for optimum management, planning, and operation. This is a continuation of an ongoing effort.

4. Analysis of the Economic Impact of Postaccident Production Losses in Underground Coal Mines

Objective: To verify, through analysis of historical data, that significant reduction in productivity is experienced in underground coal mines for up to several months after the occurrence of an accident that results in serious injury or death. An algorithm shall be developed to estimate the economic impact of postaccident production loss. This is a continuation of an ongoing effort.

Test Facilities

5. Support, Maintenance, and Security at Test and Evaluation Program Site at the Jenny Mine

Objective: To provide the necessary facilities and all necessary support, maintenance, and upkeep for the Bureau's Test and Evaluation Program to be conducted at the Jenny mine. This is a continuation of an ongoing effort.

Explosives

Program Objectives: To assess the problems associated with the safe and effective use of explosives in all types of mining activity; these include fixed explosives, blasting agents, blasting devices, and blasting accessories. To conduct fundamental studies of explosive behavior and apply the results in the development of new technology. To develop new and improved test procedures, as new mining methods are introduced and new types of explosives are formulated.

Blasting Agents and Other Hazardous Chemicals

1. Development of Nonincendive Explosive Charges for Unconfined Shooting

Objective: To develop explosive charge packages that are nonincendive when detonated unconfined. Prepackaged explosive charge assemblies consisting of a high explosive with a dispersible ignition-inhibiting agent shall be developed for use in secondary breakage and in similar applications for which there is now no safe technique. Charge packages shall be developed in a variety of sizes and configurations to cover the range of potential applications; later, they shall be submitted to the Bureau for incendivity testing. This is a new RFP.

2. Handbook of Explosive Disposal

Objective: To produce a handbook containing recommendations and instructions for the safe disposal of explosives, explosive devices, and blasting agents. A comprehensive review shall be made of recommendations for methods of disposal of these explosives, including recommendations by manufacturers, the Institute of Makers of Explosives, the Bureau of Mines, MSHA, and other agencies. Reports of accidents and incidents that have involved explosive disposal shall be reviewed. Special attention shall be given to the newer types of explosives, such as water-gels. Based on a critical analysis of the compiled information, a handbook of explosives disposal containing safe disposal guidelines shall be written. This is a new RFP.

3. The Technical, Economic, and Safety Impacts of Eliminating the Safety Fuse From Metal and Nonmetal Mining

Objective: To determine the technical, economic, and safety impacts, particularly to the samll mine operator, of the abolition of the safety fuse from noncoal mining. Research shall include reviews of the determination of the proportion of accidents directly and indirectly attributable to the use of cap and fuse. The study shall determine the technical feasibility of replacing fuse blasting, in all situations, with alternative initiation systems and shall calculate the economic consequences thereof. This is a new RFP.

Detonation Phenomena

4. Experimental and Theoretical Investigation of the Blast Wave Environment in a Mine

Objective: To measure blast waves generated from explosives detonated in underground mines and to develop theoretical methods for computing blast wave amplitudes in any mine configuration given the explosive source. This shall involve detonating fixed quantities of explosives and detonable gas mixtures in an underground mine and measuring blast pressure profiles as a function of distance from the point of explosion. Computational techniques for predicting blast wave amplitude as a function of explosive strength, distance, and mine geometry shall be developed. This is a new RFP.

5. Mechanism of Mechanical Initiation in Drilling and Mucking Operations

Objective: To determine specific causes of initiation of misfired explosives in boreholes or muck piles by drilling or mucking operations. Primed and unprimed explosive charges in boreholes shall be subjected to rock drilling to determine the relative susceptibility of various types of explosives and blasting agents to this stimulus. The same explosives charges in muck piles shall be subjected to mucking operations for the same purpose. If test results indicate that mechanical action on the explosive itself is responsible for explosions, an attempt shall be made to determine the relative role of impact and friction in initiation by their stimuli. This is a new RFP.

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